

REMARKS

The Examiner is thanked for the due consideration given the application. The specification has been amended to improve the language and to better correspond to the original German disclosure.

Claims 1, 3, 5, 6 and 10-18 are pending in the application. Independent claims 1, 5 and 10 have been amended, which find support at pages 4 and 5 of the specification. Claims 13-18 are new and find support in the specification at page 5, lines 10-14 and at page 9, lines 15-17.

No new matter is believed to be added to the application by this amendment.

Rejections Based On GENG

Claims 5 and 6 have been rejected under 35 USC §102(b) as being anticipated by GENG (U.S. Patent 6,028,672).

Claims 1, 3 and 10-12 have been rejected under 35 USC §102(b) as being unpatentable over GENG in view of PETTERSEN et al. (U.S. Publication 2002/0048027).

These rejections are respectfully traversed.

The present invention pertains to determining spatial co-ordinates of an object that is illustrated, by way of example, in Figure 1 of the application, which is illustrated below.

FIG 1

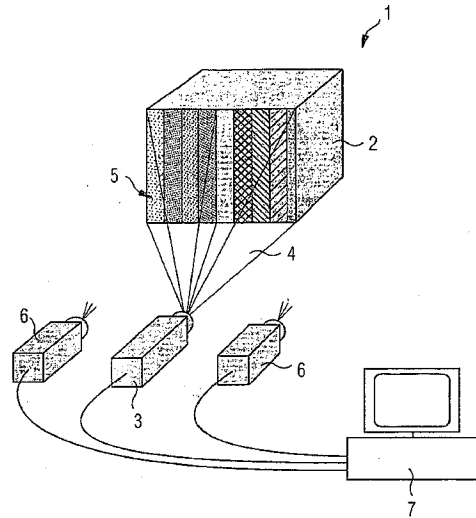
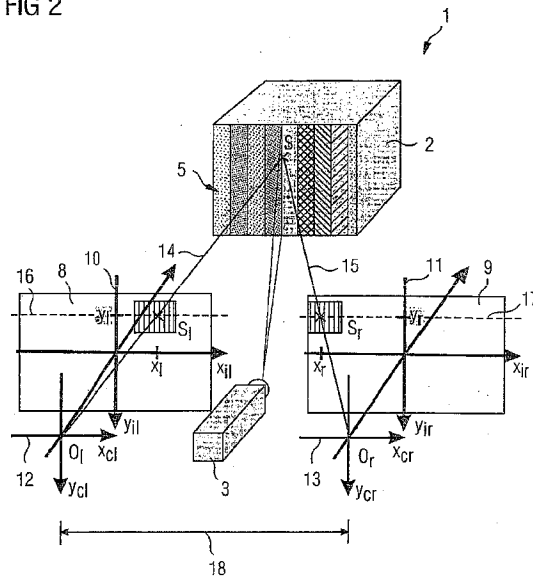


Figure 1 shows an object 2 being viewed by two cameras 6. The utilization of the special coordinates is exemplarily shown in Figure 2, which is reproduced below.

FIG 2



As shown, a projector (3) projects onto the object (2) a pattern (4) with known projection data. Two object images (8, 9) are created for triangulation. The pattern (4) contains redundant encoded projection data, and the data processing unit

(7) restricts the search for corresponding image points (S_1 , S_r) to problem areas in which an evaluation of the redundant data of the two object images (8, 9) produces an erroneous result. The data processing unit (7) determines additional spatial coordinates of the object (2) from the two object images (8, 9) by a triangulation method.

In further detail, the main idea of the present invention was originally disclosed on pages 2, 4 and 5 of the original English specification. This disclosure speaks of "*at least one further camera*" which teaches using a device having cameras and one projector. Thus spatial coordinates are determined in two ways:

a) from the two camera object images and the known projection data using a structured light approach in which the spatial coordinates of the object are respectively determined by triangulation using the known distances between the projector and the respective camera. Actually two independent measurements are performed.

b) from the object images of both cameras by a triangulation method using the known distance between the two cameras and searching for corresponding image points.

Thereby a more accurate translation of the last sentence of the English specification at page 2 would be: "*Only if a pixel in one of the two pattern images cannot be assigned to any spatial coordinates, pixels which correspond to each other*"

are looked for in both pattern images and an attempt is made, with the aid of a triangulation process, to determine a missing spatial coordinates."

Independent claims 1, 5 and 10 have been amended to better reflect this aspect of the present invention. See also new claims 13-18.

Accordingly, the present invention first uses two independent "projector-camera-triangulation" approaches and only if necessary an additional "camera-camera-triangulation" approach. GENG merely uses 1:1 "camera-camera-triangulation" approach. This can be seen in Figures 1 and 2 of GENG, which are reproduced below.

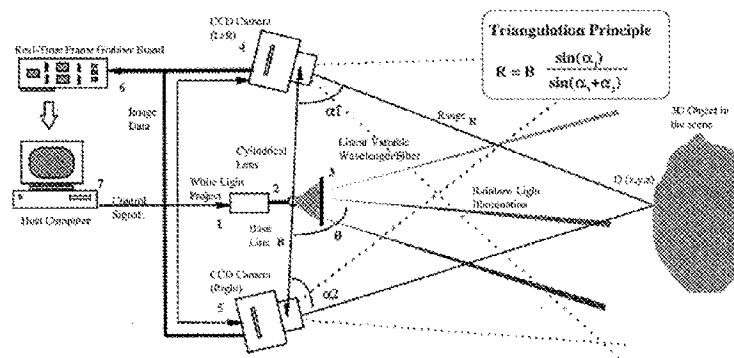


Figure 1. Operation Principle of the Rainbow Stereo 3D Camera

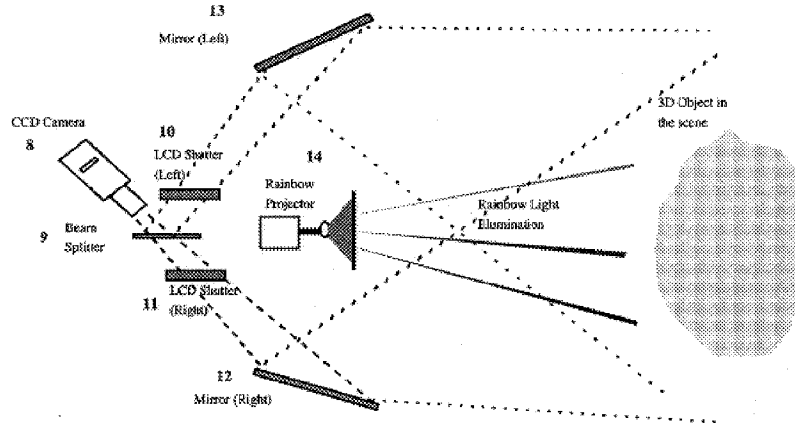


Figure 2. Implementation of Rainbow Stereo 3D Imaging Using One CCD and a pair LCD Shutter

GENG teaches: "the rainbow stereo 3D camera is based on a novel approach to producing a continuous spatially varying wavelength (rainbow like color) illumination of the scene. Two color CCD cameras or two locations of a camera separated by a baseline distance are used to capture stereo pair images of the scene at the camera's frame rate. The 3D depth values are calculated using triangulation principle by finding pixels corresponding to a common color feature in both images." Column 3 lines 34-42 and Figures 1-2.

The Office Action does not use a constant definition for the term "baseline distance" throughout. According to the above recitation a "baseline distance" is a distance between two camera locations. For example, according to page 11, lines 1-2

of the Office Action "*baseline distance*" is seen as the distance between a camera and the projector.

In contrast, the present invention utilizes two cameras to determine spatial coordinates in two ways (as discussed above):

a) by triangulation using the known distances between the projector and the respective camera, and

b) by triangulation method using the known distance between the two cameras and searching for corresponding image points.

That is, GENG teaches a method for determining spatial co-ordinates of the object, in which a rainbow color pattern is projected onto an object and in which a camera creates an object image of the pattern projected onto the object.

Moreover, GENG does not disclose determining additional spatial co-ordinates by a triangulation method in problem areas, in which an evaluation of the redundant data of the object image produces an erroneous result, since GENG does not evaluate redundant data of the object images, but computes a variance of intensity over a window area surrounding each pixel of the object image (see GENG at column 10, lines 8 to 11).

The use of redundant encoded projection data is also not disclosed in PETTERSEN et al. In addition, PETTERSEN et al. do not disclose the projection of any pattern at all.

Additional distinctions of the present invention over GENG and PETTERSEN et al. are of record in the application which, for brevity, are not repeated here.

GENG thus does not anticipate a claimed embodiment of the present invention. One of ordinary skill and creativity would thus not produce a claimed embodiment of the present invention from a knowledge of GENG and PETTERSEN et al. A *prima facie* case of unpatentability has thus not been made.

These rejections are believed to be overcome, and withdrawal thereof is respectfully requested.

Conclusion

Prior art of record but not utilized is believed to be non-pertinent to the instant claims.

The objections and rejections are believed to have been overcome, obviated or rendered moot. No issues remain. The issuance of a Notice of Allowability is accordingly respectfully solicited.

The Commissioner is hereby authorized in this, concurrent, and future submissions, to charge any deficiency or credit any overpayment to Deposit Account No. 25-0120 for any

additional fees required under 37 C.F.R. § 1.16 or under 37
C.F.R. § 1.17.

Respectfully submitted,

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